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ABSTRACT

During the next 25 years, the number of Americans over age 65 is expected to reach 50 million. Although many will not experience age-related visual impairments until the age of 60 or 70, some will begin to experience serious problems by the age of 40. The types of vision problems experienced by individuals as they age include difficulty in adapting to sudden changes in lighting, reduced color and depth perception, increased difficulties in dealing with barrages of visual information, and sight-threatening diseases such as diabetic retinopathy and glaucoma. As older workers continue to constitute an increasing portion of the labor force, the implications of age-related visual impairments become an increasingly important issue for employers. Many responses to this problem are possible. Improved eye care and screening techniques can help catch problems before they interfere seriously with work. Simple and inexpensive redesign of the workplace can help compensate for diminished eyesight. Retraining and closer matching of visual skills to work requirements can keep workers on the job longer. In addition, several private and government groups currently provide advice and resources for workers with vision impairment and for their employers. (MN)

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EYES ON THE WORKPLACE

by Ron Cowen
for the Committee on Vision

Commission on Behavioral and
Social Sciences and Education
National Research Council

NATIONAL ACADEMY PRESS
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PREFACE

At the request of the Veterans Administration and the National Institute on Aging, the National Research Council's Committee on Vision established in 1985 the Working Group on Aging Workers and Visual Impairment. The working group was asked to examine the issue of keeping older workers in the labor force longer, given the many changes in vision that occur with age.

In order to accomplish its task, the working group organized an invitational conference to review the several dimensions of work, aging, and vision. Twenty-eight specialists, including members of the working group, met for two days at the National Academy of Sciences in Washington, D.C., in February 1986. These specialists were drawn from the fields of gerontology, economics, sociology, statistics, psychology, political science, optometry, ophthalmology, human factors engineering, and physiology. Conference participants were asked to identify and describe major research findings related to changing visual capacities and the employment of older workers, to recommend steps that could be taken by businesses to encourage the continued productive employment of older workers, and to identify research topics that have yet to be explored that might bear on this subject.

Four panels were formed to explore various aspects of work, aging, and vision, including relationships between visual changes with age and changes in behavior; the role of health status in leaving the work force; the effects of changes in vision on job skills; screening practices; the availability of visual prosthetics; and economic incentives and disincentives for keeping older workers employed. A report based on conference papers and discussions has been prepared by the working group and published under the title *Work, Aging, and Vision* in 1987 by the National Academy Press.

Conferees provided a rich assortment of ideas from which the working group selected those it felt would be of most interest and use to workers and employers. This pamphlet, prepared by science writer Ron Cowen, is based on the proceedings of the conference and working group discussions, supplemented by additional research materials. Individual chapters and the entire book were reviewed by conference participants and by reviewers selected by the National Research Council.

On behalf of the Working Group on Aging Workers and Visual Impairment, I would like to thank each of the speakers who addressed the

conference and to express our special appreciation to Ron Cowen for preparing this summary of our deliberations, and to Pamela Reznick for the design of this book. We would also like to thank Pamela Ebert Flattau, staff officer of the Committee on Vision, for overseeing the activities of the working group and the completion of our reports, and Patricia A. Anderson, who served as consultant to the committee on this project, contributing significantly to the design and scope of the February meeting. Carol Metcalf, the committee's administrative secretary, provided valuable secretarial and administrative assistance. To all of these, we express our thanks for their efforts.

Robert Sekuler, *Chair*
Working Group on Aging Workers
and Visual Impairment

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The Committee on Vision is a standing committee of the National Research Council's Commission on Behavioral and Social Sciences and Education. The committee provides analysis and advice on scientific issues and applied problems involving vision. It also attempts to stimulate the further development of visual science and to provide a forum in which basic and applied scientists, engineers, and clinicians can interact. Working groups of the committee study questions that may involve engineering and equipment, physiological and physical optics, neurophysiology, psychophysics, perception, environmental effects on vision, and treatment of visual disorders.

In order for the committee to perform its role effectively, it draws on experts from a wide range of scientific, engineering, and clinical disciplines. The members of this working group were chosen for their expertise in research related to the aging of the human eye and for their familiarity with the application of those research findings to employment issues. This report reflects their evaluation of our present understanding of the interactive effects of work, aging, and vision.

This publication and its dissemination have been made possible by funding from the Veterans Administration and the National Institute on Aging of the National Institutes of Health. David Worthen, assistant chief medical director, Veterans Administration, and Leonard Jakubczak, National Institute on Aging, provided valuable guidance to the working group and the Committee on Vision throughout this effort.

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PART 1

Introduction

About 25 million Americans are 65 and older. That figure will double during the next 25 years. Over the next 15 years, the baby boom generation will swell the ranks of middle-aged workers.

But the numbers tell only half the story. The gradual decline in visual functioning that usually accompanies aging often goes undetected or is deemed untreatable.

Older people may have difficulty seeing at night, reading small print, distinguishing similar colors, or coping with glare from a desktop or video display terminal. Yet most older Americans do not have severe impairment, and only about 10 percent have eyesight so poor that they can barely see the largest printed line on an eye chart. Age-related visual impairment is highly variable. It may become significant as early as age 40, or it may not pose a problem until well into the 60s or 70s. Unless they have a major eye problem, however, most workers do not see eye specialists or undergo regular eye checkups.

Many people think of impaired vision as an inevitable part of aging for which little can be done. Some fear that if they ask for help, their job will be in jeopardy. More than likely, most older people are simply unaware that their eyesight has deteriorated.

Yet there are simple, often inexpensive methods to enhance the eyesight of older workers. Providing stronger lighting, increasing color contrast on stairwells, repositioning a desk or video display terminal to reduce glare—these are changes that most companies can afford to make. Providing regular eye checkups for workers over 40 can catch problems early, when they can be most effectively treated. In addition, giving older workers specific job training and encouraging them to practice visual tasks may help them compensate for their declining sight and profit from their learning skills and years of expertise.

A corollary is that money invested in retaining older workers with impaired eyesight may be well spent: older employees take about the same amount of sick leave and are as productive as their younger counterparts, according to recent studies.

In short, many businesses, like many workers, are unaware of methods to improve vision or accommodate impaired vision. Better vision improves the quality of life for workers and can boost productivity.

What the middle-aged Ben Franklin said about his invention of

"I am a camera, with its shutter open . . . ."
—Christopher Isherwood

When a beam of light reaches the eye, it first encounters the cornea, a tough, dime-sized membrane that is kept moist and nourished by tears. The cornea's rounded, bulging shape, like a convex camera lens, bends light rays together to form an image at the back of the eyeball. It is the cornea that provides virtually all the focusing power needed to see objects more than 20 feet from the eye.

Behind the cornea is the iris, a doughnut-shaped piece of tissue that is the gateway for light in its journey to the back of the eye. Opening and closing like a camera's diaphragm, the muscles of the iris regulate the amount of light entering the pupil, the opening in the center of the iris. In a dark room, the pupil grows to 16 times its size in bright light.

Light passing through the pupil strikes the lens, a transparent structure about the size of a lima bean. For distant objects, the lens thins and flattens, decreasing its ability to bend light rays. For nearby objects, which cannot be focused by the cornea, the lens fattens and bulges, increasing focusing.

"double spectacles" (bifocals) holds true today in redesigning the workplace for older people:

[Without glasses] I cannot distinguish a letter, even of large print, but am happy in the invention of double spectacles, which serving for distant objects as well as near ones, make my eyes as useful to me as ever they were. If all the other defects and infirmities were as easily and cheaply remedied, it would be worth while for friends to live a great deal longer.

JONATHAN TAYLOR/UNPHOTO

PART 2

The Aging Eye

If the eye is a camera, its photographic components lose precision with age. Nearly all the structures that bend, guide, and transform light entering the eye change with age—some dramatically, some only slightly—reducing the amount of light reaching the retina. In fact, eye specialists have estimated that the retina of a 60-year-old typically receives one-third the light of a 20-year-old's retina.

Light may be limited even before it strikes the cornea. Baggy or droopy eyelids, which may occur after age 40, cut down on available light. Thinning of the eyelids with age, for example, may cause skin from the upper lid to protrude like an awning over the eyelashes, restricting the field of vision. Or the lower lid may turn inward, rubbing against the eye and causing pain and tearing. If these conditions are serious, plastic surgery may be recommended to alleviate them.

The aging cornea not only flattens, limiting the ability to focus, but may also be flecked with fatty deposits that reduce transmission of light. Increased scattering of light gives the cornea a yellowish tinge, reducing the luster of aging eyes. The cornea also loses sensitivity to touch with age, so injury to the eye's protective surface may occur without pain or other warning.

The smaller opening of the pupil with age, a condition known as senile miosis, markedly limits the amount of light falling on the retina. The disorder may be most serious in dim light, because the aging pupil's maximum diameter may only be one-fourth that of a younger eye. One possible benefit of the smaller diameter, akin to choosing the smaller opening of a camera lens, is enhancement of depth of field—objects both near and far are more likely to be in focus, although they appear dimmer. In fact, some older people may report improvement of eyesight, apparently due to smaller pupil size.

Yellowing or clouding of the lens is another factor in reducing illumination. In addition, the yellowing lens also acts as a filter, absorbing more blue and violet light. This changes the perception of

This section includes material from the presentations by David Michaels, Meredith Morgan, William Kosnik, Leon Pastalan, Sara Czaja, Chris Johnson, and Robert Sekuler at the Invitational Conference on Work, Aging, and Vision.

colors: white objects may appear yellow, and the distinction between blues and greens is decreased.

Structural changes in the vitreous body, a large gel-like region that lies between the lens and the retina, have several implications for the elderly. In the aging eye, the vitreum liquefies and the gel portions clump together, causing spots, or floaters, to appear in the field of vision. The same change may trigger the vitreum to detach and pull away from the retina. The extra force may cause swelling of the macula, bleeding, or even detachment of the retina, resulting in severe impairment or loss of vision. Vitreous detachment is usually sudden, triggered by a jolt or other physical injury, and older workers exposed to large and frequent vibrations may be at high risk.

Light reaching the aging retina encounters fewer nerve cells than it does in younger eyes. For example, the number of light-sensing cones in the most sensitive area of the retina (the fovea) may decrease dramatically between age 40 and age 60. This is believed to affect the clarity of eyesight. Electrical measurements of visual activity of the brain, recorded from the scalp, appear to indicate that visual processing is slower in the elderly. Other age-related changes in the retina and the eye's nervous system are under study.

No older patient is typical. Although only about 17 percent of elderly people are severely visually impaired, quality of vision varies widely. For example, 60 percent of older people have near-perfect (20/20) vision with eyeglasses; about 40 percent have 20/40 vision or worse, discerning only at 20 feet what a person with normal vision can still see at double the distance.

A common problem among people over 40 is presbyopia, a gradual decline in the ability to focus on nearby objects and small print. The condition occurs when the lens of the eye hardens, losing the soft, pliable quality that enabled it to change shape for focusing. There is no cure, but eyeglasses and contact lenses help compensate for reduced vision. During their 40s and 50s people may change glasses every two years due to increased hardening of the lens.

Changing Eyesight: Significance for Daily Living

One of the challenges in helping the older worker is determining the extent to which visual impairment affects both job performance and the quality of everyday living. Although there have been numerous studies on aging and vision, little of this research has examined the special problems of vision in the workplace. Recent studies suggest that a slowdown of the visual nervous system may be just as crucial to worker performance as changes in the optics of the eye. Visual processing centers deep within the brain may be involved in these changes, and standard clinical tests are not designed to detect such problems.

Glare, for example, has a stronger effect with age, making it more

THE RETINA

The lens focuses light on the retina, a tissue thin as an onion skin that lines the inside of the eyeball. Crisscrossed with veins and arteries and containing more than 130 million individual light detectors, the retina is the eye's version of photographic film. The light detectors, special types of nerve cells, convert light into electrical signals that carry information. These signals, traveling about 300 miles per hour, are transmitted to the brain through the optic nerve.

The retina actually contains two kinds of light sensors, and both are named for their shape. In the majority are the 120 million rods, which provide only black-and-white vision and are found throughout the retina except at its center. The rods are most adept at detecting dim light. In contrast, 10 million or so cones respond to color and bright light and are concentrated at the center of the retina, known as the fovea. The pinhead-sized fovea, along with the yellowish surrounding area, known as the macula, are the headquarters for the type of vision needed for reading fine print and sewing. This area of the retina often degenerates as people age.

Both rods and cones use pigments to initiate the conversion of light into electrical signals. Each cone, for example, contains a pigment that is most sensitive to either blue, green, or red light. Any single light beam will trigger chemical reactions in each of the three types of pigmented cones, creating tiny electrical signals that the brain uses to distinguish among more than 150 hues. Rods, on the other hand, contain only one pigment, rhodopsin, which is bleached by light into two colorless molecules. The bleaching process sets off electrical impulses that are passed to the optic nerve.

difficult to see. At the workplace, glare from the screen of a word processing terminal may cause more problems for older people than for their younger colleagues. Since glare can be minimized, awareness of the problem may be enough to improve worker efficiency and improve eyesight.

Sometimes special methods of training may help older workers perform visual tasks successfully, minimizing the effects of normal aging of the eye. Human factors engineer Sara Czaja at the State University of New York at Buffalo and other researchers have found that older people can be trained to inspect manufactured parts for defects despite

the visual demands of the task and the limitations of their visual function. But the job training methods that worked best with older people differed from traditional techniques. Active, learning-by-doing methods are more effective than methods that require memorization. Some studies have shown that allotting extra training time and giving immediate feedback dramatically improve the performance of older workers. These methods of compensating for age-related impairment of vision may also benefit younger employees.

Changes in Lighting

Older people may have difficulty in adapting to sudden changes in lighting. It may take their eyes a few extra minutes to adjust from a darkened hallway to broad daylight. In the laboratory, older people's eyes took longer to react and adjust to the bright light of a flashbulb.

A recent survey in the Chicago area revealed that adapting to bright lights was one of eight eye problems commonly reported by both young and old people.

Looking at Life Through Cloudy Glasses

One survey took a unique approach to learning about impaired vision: five young architecture students wore specially coated glasses that simulated glare and allowed only one-fourth of available light to reach their eyes. The glasses also reduced eyesight to 20/40 vision. According to the study designer, Leon Pastalan of the University of Michigan, the lenses of the glasses scattered light, simulating a condition "that most people will eventually be reduced to if they live long enough—although some might not experience it until their 60s or 70s."

Students in the study, who wore the glasses periodically for six months, kept a log of their observations and reactions in three standard settings—the home, a shopping center, and a senior citizens' center. Glare from both artificial and natural light was the predominant complaint among participants. For instance, the group found that light streaming in on a supermarket window obliterated most of the printing on packages on nearby shelves. Moreover, intense light from a single artificial source created more uncomfortable glare than light from several less intense sources.

The students reported that colors appeared less bright, and were harder to distinguish. Boundaries between light-green walls and blue-green carpets, for example, were virtually impossible to detect. As a result, navigation in a uniformly colored environment would be hazardous. Impaired depth perception and decreased sensitivity to color contrast were a double threat for walking down stairs—both conditions made it difficult to judge the location of steps, especially if riser and tread were painted similar colors.

To alleviate these problems, which are also common complaints of older people, Pastalan recommended a number of design changes in the workplace. Glare can be reduced by using materials that are poor light reflectors. Signs should be printed in high-contrast colors; white symbols on a dark background are preferable to the more common black-on-white lettering. Printed matter and other visual information should be free of glare and displayed in an easy-to-read location. The use of stairs should be minimized. Reds and yellows should predominate in areas where color accents are needed. Finally, both overhead and desk lighting should generally be increased.

Other studies have also found that sensitivity to contrast, which determines one's ability to perceive details of an object or scene, decreases with age. Colors become more difficult to distinguish, driving in the low light of twilight may be hazardous, and picking out individual faces in a crowd may be nearly impossible in dim light. Scientists have found that older persons find it hard to detect objects that are clustered together rather than spread far apart. For example, it may be difficult for an older person to read a large-print book if there is insufficient white space between the black letters.

Older people's ability to distinguish between visual events that occur in sequence is sometimes impaired. In laboratory experiments, events that appeared entirely separate to younger observers seemed to the elderly to overlap.

Clutter

Drive along the main road in County Kerry, Ireland, and you're likely to come screeching to a halt. A typical signpost points left to Black Head, right to Lisdoonvorna, northeast to Ailwee Cave—there is a jungle of arrows pointing in eight different directions, and most people need time to search out the one direction they want. In the same way that a confusing signpost may stump drivers, the barrage of visual information from a cluttered work area may prevent employees from performing a task quickly.

Scientists simulate these and other real-life conditions in an effort to bridge the gap between academic research and the workplace. At Northwestern University, researchers tested the ability of young and old volunteers to pick out a cartoon face from a jumble of other images flashed on a television screen. The experiment was conducted in two parts. In the first, volunteers were asked to locate a small cartoon face that appeared for only a tenth of a second on a television screen.

Young and old members of the group performed this task equally well, but then things got tougher. The Northwestern researchers, headed by Robert Sekuler, added a series of distracting images to each appearance of the cartoon figure. Like the cluttered signpost in County Kerry, the extra images scattered about the screen made it more difficult to

locate the desired figure. Older people averaged twice as many errors as younger people.

The researchers took their test a step further. The group of older volunteers was asked to practice the video test, typically repeating it 64 times in 3 days. At the end of the practice sessions, the older group performed as well as the younger one. Sekuler strikes a cautiously optimistic note about these results: although the performance of many visual

DIABETIC RETINOPATHY

Among the complications of diabetes is a disorder that damages the blood supply to the retina. Older diabetics, particularly those who have had the disease for more than five years, are at risk for diabetic retinopathy. According to a 1978 estimate of the National Society to Prevent Blindness, 40 percent of the nation's 10 million diabetics have at least a mild form of the disorder, and about 3 percent have severe visual impairment.

Early stages are marked by deterioration and ballooning of small blood vessels that nourish the eye. Researchers are unsure why the eye's circulatory system weakens in diabetics, but fluid leaking from the vessels is known to collect and settle in the retina. Although blurring of vision may occur if fluid collects in the macula, 80 percent of patients experience no symptoms at this stage. As the disease advances, severe impairment and blindness may result.

Lasers can be used to treat leaky blood vessels, preventing additional damage to the retina. In addition, if leaking fluid has clouded the clear eye fluid, known as the vitreous humor, it can be surgically replaced. Because diabetic retinopathy has few, if any, early symptoms, doctors recommend that diabetics receive periodic eye checkups.

Among the visually impaired workers at one company is Dan N., a 59-year-old drill press operator employed there for 16 years. A supervisor suddenly noticed that Dan had become error-prone and was scrapping an unusually large number of parts. He referred Dan, already under the care of an eye specialist, for an exam. The medical staff diagnosed the problem as diabetic retinopathy. Dan, who had a reputation as a good worker, would not be eligible for optimum retirement benefits for three more years. The firm kept him on but transferred him to the day shift and changed his job assignment to machine parts finisher. This task did not require the near-perfect vision needed for finely detailed machining, and Dan remained productive until his retirement.

tasks cannot be improved by simple training or repetition alone, practice may help boost the capabilities of older people in the work force.

Driving

Driving is one area that has been studied extensively outside the laboratory by vision scientists. The visual skills used on the road are similar to those needed in the workplace, and the number of drivers over the age of 65 is rapidly increasing.

Elderly drivers have a different profile of accidents and violations than the young. Although older people have few high-speed accidents or major violations, they are prone to mishaps caused by failure to heed signs, give right-of-way, or turn safely.

Among a group of drivers in California, researchers recently determined that accident rates were twice as high for people with reduced peripheral (side) vision in both eyes as for the group at large. One important and surprising result of this research was that 60 percent of the people in the study whose vision was impaired were unaware of their problem.

Eighty percent of the people in the study with reduced peripheral vision in the study were over age 65; however, only those with impairment in both eyes had a higher accident rate. Other tests have shown that cataracts, glaucoma, and retinal disorders are common causes of loss of peripheral vision among drivers.

Researchers have discovered in the laboratory that older people have difficulty identifying one shape or symbol, such as a stop sign, when it is surrounded by extraneous symbols. Older individuals appear to be distracted from visual tasks more easily than younger people when presented with competing messages.

Although perceptual and visual processing problems of the elderly are still under intense study, many eye diseases and dysfunctions can readily be identified and treated by eye specialists, especially if caught early. Among these are glaucoma, cataracts, eye complications associated with diabetes, and degeneration of central, or macular, vision.

HAUCKE HOSKING/UNIPHOTO

PART 3

In the Workplace

In 1713, Bernardo Ramazzini, one of the first chroniclers of job-related illnesses, offered little hope to workers who suffered from poor eyesight. He advised blacksmiths with eye pain "to apply woman's milk and barley water" and to consider bloodletting "if there be acute inflammation."

Printers who developed eyestrain were even worse off. Declared Ramazzini,

> I fail to see that the art of medicine can give any kind of help to these workers . . . or what safeguard can be suggested, except that they should be warned to spare themselves when they are doing this sort of work, to snatch some hours of the day from their toil, and when they leave the shop in winter they should wrap well before they go home.

Today we can rely on more than woman's milk and barley water to help the worker with vision problems remain on the job. Improved eye care and screening techniques help catch problems before they interfere seriously with work. Simple and inexpensive redesign of the workplace can help compensate for diminished eyesight: a strategically placed, high-intensity desk lamp can shed extra light on a visual task; glare from a window or overhead light can be reduced; labeling tools, desktop equipment, and even stairways with high-contrast colors may enhance visibility.

Retraining and closer matching of visual skills to work requirements can keep older people on the job longer. In addition, several private and government groups provide advice and resources for workers with vision impairment and their employers.

Among the visual aids tailored to the individual are high-powered prescription eyeglasses and magnifying glasses that cost under $100. More expensive items, such as talking computers and closed-circuit television systems that magnify print, are permanent resources that can be used successively by many workers.

This chapter includes material presented at the conference by Ian Bailey, Roberta Alex, Louise Birkholz, and Bruce Rosenthal.

To be used effectively, these resources and techniques must go hand in hand with knowledge of the needs of companies and of their workers. Are some jobs more easily handled by older workers than others? Are businesses generally interested in methods to retain long-term employees? How many older workers, faced with changes in vision that interfere with job performance, would rather retire than accept a new assignment? These questions have only recently come into focus, in part because few statistics keep tabs on older workers with impaired vision. Answers to these questions will become more important, and resources to assess and treat eye problems on the job will become more critical, as the average age of the American worker continues to increase.

Vision Care on the Job

Regular eye checkups and a company health care program that includes vision monitoring are still the most effective ways of identifying and keeping people with impaired vision in the work force, according to ophthalmologists, optometrists, and rehabilitation experts. Annual eye examinations may catch problems early, when drugs, surgery, or other treatment are most effective. For example, early detection can usually halt, although not reverse, eye damage due to glaucoma, a leading cause of blindness. A checkup may also reveal cataracts, which can be surgically removed to prevent blindness. Even if a specialist determines that further deterioration of eyesight is inevitable, the worker at least has additional time to adapt to the condition and seek help, both on and off the job. Through the efforts of unions in collective bargaining, larger numbers of U.S. workers and their families now have access to vision care. According to a study by the Bureau of National Affairs, 40 percent of collective bargaining plans contained vision care programs in May 1986. This compares with only 3 percent in 1975 and 10 percent in 1979.

A Tale of Two Companies

Two firms that provide vision care as part of their health benefits package are the S&C Electric Company in Chicago and the Convair division of General Dynamics Corporation in San Diego. Their vision care programs can serve as models for other companies, both large and small.

More than Safety Glasses

These companies go far beyond providing the standard safety glasses and goggles required by federal regulations in many manufacturing plants. Convair, for example, conducts more than 3,000 free basic eye examinations each year. Every new worker receives a physical examination, including testing for visual acuity and retinal diseases. About 1,800 out of 12,500 employees—those who assemble and manufacture compo-

nents—receive follow-up eye tests annually. Both eyeglasses and complete eye examinations are available at a discount.

Older workers who develop presbyopia—impaired ability to focus on objects close up—are required by many companies to wear prescription glasses at all times. Metalworkers and drillers at Convair are issued goggles and face shields, as well as the required safety glasses. Visually impaired workers are supplied with magnifying glasses and extra lighting, including high-magnification, high-intensity inspection lamps. These workers are limited to daylight hours, and their tasks may be restricted.

Free Eye Care at a Small Company

Paralleling Convair's vision care program is that of S&C Electric Co., a firm with 1,350 employees that manufactures high-voltage switches and fuses for utility companies. A local optometrist visits the firm for free eye examinations twice a month, and since the 1950s the firm has provided all employees with free prescription glasses, in addition to safety glasses, if needed.

The optometrist sees about 25 people in a half day, about 600 in a year. Prescriptions for glasses are filled at a cost to S&C ranging from $15 to $30—the employee pays nothing. An ophthalmologist is on call in the event that eye injuries or special eye problems need immediate care.

Many, but not all, S&C employees receive the free eye examinations. These people include all new employees in the manufacturing area; all workers age 60 and over, forklift drivers and others who operate vehicles, and those who assemble solid-state electronic parts. Other workers in the manufacturing area and persons whose jobs often take them into that part of the building are given eye exams once every two years.

According to S&C's medical aid administrator, eye problems are most common in workers over the age of 35. Cataracts, glaucoma, and visual problems arising from diabetes have been detected—conditions that might otherwise have gone unnoticed.

Job Coding

A unique feature of the Convair program is that the physical abilities of each worker, including vision, are coded and matched to job tasks. The codes, which also indicate such conditions as hearing impairment and sensitivity to chemicals, are designed to protect the worker's health, enhance safety for fellow employees, and improve productivity, according to Roberta Alex, medical supervisor at Convair.

For example, a worker who has good vision in only one eye (better than 20/40 with glasses in one eye, but less than 20/70 in the other) is coded for wearing safety prescription glasses at all times. Both the supervisor and the employee are notified and educated about the code, and such a worker would never operate a crane or perform other tasks

GLAUCOMA

The National Eye Institute estimates that glaucoma accounts for more than 12 percent of all reported cases of blindness. A recent analysis of data from the 1960s indicates that blacks develop the disease at a rate 8 to 16 times that of whites, and at an earlier age. Nearly 2 million Americans age 35 and over, or 1 out of every 50 people in that age group, have the disease, according to the National Society to Prevent Blindness. The older the person, the greater the risk: 3 out of 100 people age 65 and over have glaucoma.

Glaucoma occurs when the natural fluids produced in the eye do not drain away but collect and exert pressure inside the eyeball. If left untreated, the pressure eventually destroys fibers in the optic nerve and blindness results. Loss of peripheral vision is the main symptom, but by the time patients are aware of the problem, considerable damage has usually occurred. Regular checkups for glaucoma, usually recommended after the age of 40, can catch the problem early.

Doctors use three standard tests for diagnosis. Photographing the back of the eyeball can indicate telltale indentations of the optic nerve, called cupping, which is one of the earliest signs of disease. Measuring eyeball pressure with a tonometer, a sensing device that either lightly touches the surface of the eye or aims a gentle stream of air at the eyeball, catches abnormalities early on. The third test examines the patient's field of vision.

Glaucoma can usually be controlled, but not cured, with special eyedrops and other drugs. For some patients, surgery, including laser therapy, may reduce pressure from fluid buildup.

that require good vision in both eyes. A worker with better vision has a less restrictive code and can perform a wider range of tasks. Separate codes are used for people with color blindness or reduced sensitivity color; these employees would not work with color-coded wires.

Benefits of Company Vision Care Programs

Increased safety and higher productivity are prime motivators for including vision care in the company health package. There may be other reasons as well. Reductions in force may leave a company with substantially fewer employees, many of whom, due to their seniority, are older. The companies might then take a special interest in retaining and monitoring the health of older workers who are productive despite minor

visual impairment. If the firm begins rehiring, it may find that its older managers are invaluable in passing on knowledge to junior staff. Maintaining the visual health of older workers may play an important part in retaining experienced employees.

In the words of one industrial health specialist, a company's eye care program "costs absolutely nothing" compared to the resulting increase in employee morale, early detection of disease and preservation of eyesight, improvement in work performance, and added safety in the workplace. Rather than being operated separately, as a costly white elephant, vision care services can easily be integrated with other health care benefits offered by a company.

BOB DAEMMRICH/UNIPHOTO

PART 4

Redesigning the Workplace

What can be done to aid people whose declining vision interferes with working? To begin with, visual tasks may be more complex at the workplace than they seemed in the doctor's office. For example, because the range of clear vision in an older person is extremely small for nearby objects—things start to go out of focus an inch or two from the optimal distance—using video display terminals may be especially troublesome. The screen, the keyboard, and the material being typed are all at different distances, and none corresponds to the distance at which one usually holds a book or newspaper. Separate optical corrections may have to be prescribed for video display and reading tasks, although the two activities seem similar.

If an older worker is confronted with new equipment or a new visual task, a new set of bifocals or progressive focal lenses may be required. In fact, if the work site can be inexpensively redesigned so that all critical visual tasks lie within the tightly limited range of good vision of the elderly worker, job efficiency and comfort might both be enhanced.

Coloring the Job

High-contrast images are usually easiest to see. Older workers may therefore have difficulty viewing the green-on-black lettering of a typical video display terminal.

Older people often lose sensitivity to blues and greens. Reds and yellows, which are easier to see, could be used instead whenever a color accent is needed. Loss of contrast is another problem for older workers, especially those with cataracts or glaucoma. The ability to distinguish between light and dark shadings may be particularly crucial for navigating stairs, since the riser and tread are usually the same color. Contrasting strips of red or yellow, or other bright colors, may make the steps more visible. A similar use of colors can make it easier to distinguish among desktop articles or machine parts that have low contrast. Placing a piece of yellow cellophane on top of a note written in blue ink will darken the

This chapter includes material from presentations at the conference by Sara Czaja, Timothy Salthouse, James Fozard, and Alan Lewis.

lettering, thereby increasing the contrast between the ink and the paper and making the message legible.

Light and Glare

Extra lighting can dramatically improve the visual ability of older workers, particularly those with macular degeneration. The smaller opening of an older adult's pupil welcomes added light, yet because glare is a problem for the elderly, spot lighting should not be provided indiscriminately. In the same way that bright light streaming through a supermarket window can make it difficult to read the lettering on packages, a lamp backlighting an object may cause difficulty in focusing.

More than 1,500 years ago, the Chinese monk Song Yun cited the effects of glare in his Travel Notes: "Light radiation off snow dazzles

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DISEASES OF THE RETINA

Impairment of the macula, a yellowish area in the center of the retina that provides sharp central vision, is the leading cause of severe visual impairment among people age 65 and over.

The most common type of macular degeneration begins late in life, usually after age 60. Known as age-related, or senile, macular degeneration, this disorder takes two forms. About 90 percent of older patients have the less severe dry form, characterized by white or yellow lumps that form under the macula and can destroy light-sensitive cones. Although most patients retain useful vision, there is no effective treatment for the problem.

About 10 percent of patients have the more serious wet, or neovascular, form of the disease. In this disorder, fragile blood vessels grow beneath the macula, leaking blood and fluid into the central region of the retina and eventually destroying nerve cells. Serious visual impairment can result, but this type of degeneration may be treated with laser therapy if caught early.

Early warning signs of wet degeneration are blind spots in the central field of vision and the appearance of straight lines as wavy. A simple self-test, conducted daily, can detect these problems. Covering one eye at a time, a person focuses on an object with straight lines, such as train tracks or a telephone pole. Any perception of waviness should be checked by a specialist. Alternatively, a similar test can be performed using a card printed with a special grid pattern, called the Amsler grid. Again covering each eye in turn, vision is focused on a dot in the center of the grid. Any apparent waviness or gaps in the grid should be followed up by an eye examination.

people's eyes so that they are unable to see." More recently, sensitivity to glare has boosted the popularity of the typoscope, an inexpensive gadget that aids some partially sighted older people in reading print. The device is merely a black or dark gray piece of rectangular cardboard with a window cut out of its center. The window is large enough to frame a few lines of type when placed over a printed page, the rest are blocked by the black or gray cardboard. The dark outline of the typoscope usually makes it a little easier for older people to read print, probably because it eliminates light scatter and glare from other lines of type.

On-the-Job Experience, Retraining, and Compensating for Impaired Vision

The possibility of retraining older workers, whether they have good eyesight or not, is often overlooked. The stereotype still persists that older people are either incapable of or uninterested in learning new tasks, but there is encouraging evidence to negate this image.

In the laboratory, Timothy Salthouse of the University of Missouri found that, in response to a visual cue, older typists were slower to strike a letter on the keyboard than younger workers. On the job, however, the older typists were as fast as their younger counterparts. The explanation? Researchers discovered what the laboratory test overlooked: older, more experienced typists were more likely to look ahead to the next word to be typed and position their fingers on the keyboard accordingly.

This helped them gain speed and make up for their slower reaction time. Only when workers were prevented from viewing the next word did older typists perform more slowly than their younger colleagues.

New evidence has led some scientists to believe that older workers, given the chance, can compensate for declining visual function by relying on learning ability and acquired skills. In addition, job retraining and compensation for impaired vision may be more important now than ever, as microscope work, operation of video display terminals, and other visually demanding jobs proliferate.

Training older workers in skills needed for a new job speeds up learning. One study showed that becoming familiar with the relative sizes of machined parts, for example, helped older workers grasp the fundamentals of inspecting parts.

According to Czaja, more research is needed to match job training with the specific task at hand. A 1984 study showed, for example, that commercially available training methods to teach word processing were not effective for older learners. "Unless we develop effective retraining strategies, older persons will not fit into the new work environment," Sara Czaja, SUNY-Buffalo, comments.

BOB HAKKMAN/H.T. SUPROTO

PART 5

Looking to the Future

After many decades of research on the aging eye, vision scientists are on the threshold of significantly improving the working conditions of older employees. Investigators are devoting more time to studies of suitable procedures for screening the vision of older workers, the basic visual abilities needed to perform visually guided tasks, and long-term research documenting how eyesight changes with age. Scientists are also examining how retirement decisions are affected by company policies.

These research efforts run the gamut from laboratory studies to home surveys, examination of tasks at the workplace, and analysis of large statistical data bases such as those kept by the U.S. Bureau of the Census. In conjunction with these efforts, research on normal changes in vision with age may indicate the most pressing visual problems of older people and their impact on working. Says Sara Czaja, "We need to . . . allow for developmental changes which occur as a natural function of the aging process. Therefore we need data on the type and extent of these changes and their implications for the performance of everyday tasks and activities."

Such information is vital to implementing changes in the workplace that would benefit older people. Although data on the impact of basic changes in vision, such as reduced visual acuity, increased sensitivity to glare, loss of peripheral vision, and reduced color perception, are available, little of that information has been related to daily activities or specific tasks at work.

In addition, few if any records are kept on employees with deteriorating eyesight, most of whom are older and have only minor visual impairment. These people usually accept their reduced vision as an inevitable part of aging. Yet laboratory studies and on-the-job experience suggest a variety of methods for retaining these people as productive members of the work force.

Researchers have found that eye examinations which take into account the type of lighting and visual tasks encountered at work may be

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This section includes material presented at the conference by Richard Burkhauser, Pauline Robinson, Corinne Kirchner, Hilda Kahne, Joseph Maino, Ronald Wilson, Harold Sheppard, and Arnold Small.

most effective in treating the older employee. A portable, high-intensity desk lamp has brightened the work life of many older workers, whose smaller pupils dramatically reduce the amount of light reaching the retina. Placing nonreflective material on desktops and over video display terminals reduces glare, to which older people are particularly sensitive. And both laboratory and workplace studies indicate that older workers can be trained to improve their performance on some visual tasks.

What Do Companies Want?

A basic problem with implementing retraining programs and proposed design changes is that many companies are simply not interested in retaining older workers, and not all workers wish to stay on. Early retirement plans are common, especially among larger businesses. Companies that continue medical insurance coverage after workers leave the job may inadvertently encourage early retirement. Disincentives to continue working include restrictions on increasing pension benefits after normal retirement age. With so many other predisposing factors, the extent to which age-related decline in vision affects the decision to retire is unknown.

Most companies cite cost savings as the main reason for early or mandatory retirement policies. Businesses point to the higher salaries earned by older employees, the obsolescence of their skills, increased absenteeism, and the disadvantages of holding back the careers of younger employees. Many of these reasons for retiring workers are questionable; for example, studies show that absenteeism is not significantly higher among older workers than it is among younger employees.

Economics may force companies to retain more older workers as the turn of the century approaches. The smaller population of younger people following the baby boom, the dramatically smaller percentage of men in the work force, and an expected leveling off of the number of women in the job market all point to a shortage of workers in the coming decades. Older workers may become more valuable, and the advent of flexible, part-time work plans may keep many aging employees on the payroll. At present, however, efforts to extend the work life of older people with impaired vision may be most successful in those firms that recognize the economic advantage of retaining them.

According to Pauline Robinson, formerly with the Andrus Gerontology Center, most surveys that seek to identify such firms reveal little, simply because the threat of an age discrimination suit makes companies reluctant to give unfavorable opinions about older workers. Surveys that describe pension and benefit incentives for workers may be more informative of a company's attitude toward older workers.

Harold Sheppard of the International Exchange Center on Gerontology, University of South Florida, told conferees that the ideal conditions for continued employment of older workers would include a high

demand for labor, inadequate retirement benefits, rejection of the stereotyped image of diminishing work capability associated with aging, job satisfaction, and good health. Beyond these basics, Sheppard said, are needed "special interventions ranging from education and persuasion of employers, unique labor-managment agreements, tailor-made training

MICROSCOPES, TELESCOPES, AND IN BETWEEN

For many people with impaired vision, bifocals supplemented by focused lighting and other environmental changes may be enough to improve work performance. For others, special eyeglasses with extra powerful lenses may be needed. There is a variety from which the worker and the eye specialist can choose.

Microscopic eyeglass lenses improve vision for people who can read print no more than an inch away. Depending on their strength, these lenses bring into sharper focus images that lie anywhere from 13 inches to a quarter of an inch from the eyes. The thicker the lens, the closer to the eye that objects must be held. Since the magnification of these eyeglasses is the product of the magnification of the lens and the enlargement inherent in viewing an object closeup, overall magnification can be very great.

Telescopic spectacles, on the other hand, allow extremely nearsighted people to read material comfortably at a distance. The telescopic portion is usually mounted on the top of a person's normal eyeglasses. The wearer looks through the standard lens to move about but uses the telescopic attachment to read distant detail, such as a street address or bus number. One advantage is that newspapers no longer have to be held close to the face, but these lenses reduce the amount of light reaching the eye and narrow the field of view.

A telemicroscope combines a telescopic distance lens with a reading lens that magnifies. These devices, which sometimes feature a zoom lens, focus on both near and far objects. They allow a comfortable distance for close work as well as the ability to watch television and sporting events.

Because partially sighted people often see better with one eye than the other, specialists may prescribe a low-vision device solely for the stronger, more easily correctable eye.

In addition to eyeglass attachments, there are hand-held and freestanding magnification instruments that aid in addressing envelopes, reading menus and fine print, and other close visual tasks. Closed-circuit television systems that magnify print, talking calculators, and large-print computers are other options in the workplace.

techniques for the elderly, and creative technologies that make it easier for the handicapped to work." The cost-effectiveness of these interventions, among other considerations, are only just beginning to be explored.

The Need for More Information

Another obstacle to retaining the older employee with impaired vision is the paucity of data on the number of people affected. There are many uncertainties and only a few estimates of the number of workers with reduced visual function, the percentage who are unemployed, and the number no longer seeking work due to impairment.

Most of the data are on people with severe impairment; those with vision better than legal blindness (20/200 vision or worse in the better eye) often fall through the cracks of government record keeping. Even data on people who are legally blind are outdated and unreliable according to the main source, the National Society to Prevent Blindness.

The most up-to-date information on visual impairment is provided by the National Center for Health Statistics (NCHS), Bethesda, Maryland; the Social Security Administration, Washington, D.C.; and the U.S. Bureau of the Census, Washington, D.C. The NCHS conducts annual health surveys; between 1966 and 1981 these included questions on color blindness, prevalence of eye diseases such as cataracts and glaucoma, and problems seeing with eyeglasses. (Vision questions were dropped from the annual survey in 1981.) Special NCHS surveys in the early 1960s and 1970s also assessed visual ability.

A series of studies by the Social Security Administration, the latest conducted in 1978, relates vision impairment to the workplace, but these studies have not yet been analyzed. A 1976 study by the Census Bureau included items on employment of the visually handicapped. Although it asked people who had "serious difficulty seeing or were blind" just one question—whether or not they considered themselves handicapped—the study was answered by a large number of people and provides detailed socioeconomic data. It is estimated that in 1976, 86 million Americans wore glasses and 800,000 were visually handicapped.

What We Do Know from Statistics

According to Corinne Kirchner of the American Foundation for the Blind, New York City, data from the Census Bureau and NCHS surveys show several trends, although percentages differ by source. To determine the current and future prevalence of visual impairment, Kirchner projected data collected from the decade-old surveys to the years 1985, 1990, and 2000.

All of the surveys found that visual impairment was more common among people aged 45 to 64 than among younger persons (18 to 44). The age gap was largest for moderate impairment, and Kirchner esti-

mates that this trend will continue through the turn of the century. Very minor impairments (difficulty seeing without glasses) and blindness were more evenly distributed across age groups.

According to NCHS data from the 1970s, nearly 45 percent of people who were "severely visually impaired" had other handicaps as well. The percentage increased sharply with age. These statistics indicate that multiple impairments should be considered in any effort to retain the older worker with impaired vision.

The surveys indicated that visually impaired people tend to be concentrated in blue-collar jobs, such as laborer or service worker. But there is little information available on another measure that might be useful for developing more comprehensive vision screening programs in the workplace—the age at which visual impairment begins. Kirchner stresses that self-reports of the incidence of vision problems are highly suspect, because many people are reluctant to admit the onset of impairment and the disorder may have been developing unnoticed for years. Existing surveys should be supplemented with questions on vision and employment, she added.

Driving as a Model for Working

Results from research on driving provide the clearest information on potential screening procedures so far. Screening criteria under consideration for testing of older drivers include performance under high- and low-level lighting conditions, the impact of glare on road sign identification, and the ability to distinguish details on a moving target. The efficacy of these proposed tests may suggest appropriate screening tests for older people in the workplace. New vision tests may make the difference between productive employment and loss of a job and may also help older workers keep their current position rather than face reassignment.

Health experts also stress the importance of informing businesses that simple design changes and periodic eye checkups may boost the productivity of many older employees who do not even realize they have a vision problem. The key to success, according to some scientists, is for researchers to work hand in hand with companies that have a stake in the continued health of older employees.

Efforts of Private Companies

A number of companies, including IBM, AT&T, Hewlett-Packard, and Sears, make special efforts to retain or hire people who have lost some or all of their vision. IBM recently opened an information hotline for disabled employees and the general public. Sears offers a health care catalogue that features magnifying glasses and special eyeglasses for the visually impaired. Stories abound in the workplace about people who

have retained jobs despite visual impairment. There's John B., a 42-year-old manager at IBM who developed retinitis pigmentosa four years ago; with the aid of a closed-circuit television system, he has been able to continue work and even merit a promotion. Instead of placing a visually impaired cable repairman on disability, Pacific Telephone in Santa Barbara retrained him for a desk job that used his skills to determine the proper cable needed for repair jobs.

Some companies have also become more aware of the role of preventive eye care. For example, Levi-Strauss of San Francisco recently completed a pilot study of eyestrain among word processor operators. The employees worked with a local ophthalmologist to determine if eye exercises could prevent strain.

This pilot study is just one example of the increased awareness of vision care in industry. There remains a challenge, however, to inform more businesses about the benefits of these programs and the low cost of design features that accommodate workers with impaired eyesight.

Selected Resources for Vision Care

A number of resources are available to workers and employers interested in identifying, understanding, and treating the changes in vision that occur with age.

VICTORS: A Resource for Veterans

In the mid-1970s, the Veterans Administration (VA) spearheaded a major new program to rehabilitate veterans with low vision. Known as VICTORS, the program draws upon a team of optometrists, ophthalmologists, social workers, and rehabilitation specialists to aid in the early identification and treatment of partially sighted ex-military personnel. The first of 12 planned VICTORS centers opened at the Kansas City VA Medical Center in 1979 and serves primarily people in Missouri, Kansas, Iowa, and Nebraska. A second program began operating at the West Side VA Medical Center in Chicago in 1987.

According to Joseph Maino, a VA optometrist who helped found the program, VICTORS helps keep veterans in the work force by making the best of their remaining vision, helping to modify work conditions or job tasks to match the veteran's abilities, and referring veterans to state or VA rehabilitation centers for further help.

VICTORS does not duplicate services already offered at the VA's Blind Rehabilitation Centers; it offers help to veterans who typically have considerably more partial sight than someone who is legally blind. Patients are given priority according to their employment ability, severity of impairment, and service-related disability rating.

Patients usually spend three days at a VICTORS center. During their stay, a special low-vision eye examination is conducted to determine the full extent of the problem. Additional testing, including a color

sensitivity examination, is also performed. After consultation with an optometrist to decide which low-vision aids are best suited for the veteran, a therapist begins training the patient in how to use the devices, which might include hand-held magnifiers, closed-circuit television systems that magnify print, or telescopic lenses mounted on the patient's eyeglasses. These devices are given on extended loan to the patient.

A significant sidelight of the VICTORS program is its use as a training facility for optometrists specializing in low vision. The Kansas City center has a residency program affiliated with the optometry school of the University of California at Berkeley.

Job Network

Many organizations help visually impaired workers and employers who want to hire or retain these workers. Among these is the Job Accommodations Network, which advises industry on techniques for accommodating the impaired workers, including those with vision loss. Often a firm will call the network with a handicapped person in mind for a job; the network then counsels both the prospective employee and the company representative. The network also provides information to rehabilitation therapists on job redesign, but it does not offer a placement service. Set up in 1984 by the President's Council on Employment of the Handicapped, the network's toll-free number is 1-800-526-7234.

An Index for Jobs

A resource for workers is the Job Index, an information telephone line begun by the American Foundation for the Blind in New York City. The service maintains files on more than 500 workers who have remained on the job despite visual impairment. Callers are educated about supplemental lighting and other changes in the workplace that aid people with visual disabilities. In addition to providing written information, the Job Index puts impaired workers in touch with others in a similar profession who have successfully adapted their visual skills.

Remaining on the Job in New York City

The recently established National Center for Vision and Aging, also located in New York City, seeks to bridge the gap between agencies serving the elderly and those aiding the visually impaired. Educating the public about visual impairment among the elderly and promoting research that will improve rehabilitation efforts are two of its objectives. Through booklets and video cassettes, the center has begun educating businesses about efforts to hire or retain people who are visually impaired. For example, the group discusses with medical directors of corporations the techniques of adapting the workplace to the needs of visually impaired workers. Sponsored by the New York Lighthouse for the Blind, the center is an advocate for people with considerable partial sight as well as those who are legally blind.

Another offshoot of the New York Lighthouse, the Job Retention Service, aids both visually impaired workers and businesses in the New York metropolitan area. The service, in conjunction with the Lighthouse's low-vision clinic, refers workers for eye examinations, provides counseling, and visits the work site in order to suggest ways of enhancing existing vision.

According to Neil Crouse, director of the retention service, people who contact his office tend to be clerical workers or managers, most in their 50s through mid-60s. His office helped about 20 people last year and expected to see about 50 in 1986.

Crouse commented that the biggest fear among many impaired people is that of losing their job once their vision problem becomes known

CATARACTS

Cataracts are caused by a clouding of the eye's lens, which distorts and decreases available light. Although cataracts can occur at any age, even at birth, they are most common in the elderly. The National Society to Prevent Blindness estimated in the late 1970s that 41 million Americans over the age of 40 have cataracts. According to the National Eye Institute, about 5 million people have disorders that will progress to interfere seriously with normal vision, and 700,000 undergo surgery each year to correct the problem. The effects of a cataract on vision depend on its size, location, and density. A small cataract in the center of the lens will probably affect vision far more than a large cataract occurring away from the center.

Among the symptoms are blurred or double vision and spots, problems with too little or too much illumination, change in the color of the pupil, and the sensation of having a film over the eyes or looking through a waterfall. In fact, cataracta is the Latin word for waterfall.

Treating cataracts involves two steps. First the cloudy lens is surgically removed. Then an appropriate substitute—special eyeglasses, contact lenses, or an artificial lens implanted in the eye—is chosen to replace the damaged tissue. Laser cannot treat cataracts, but it may help disintegrate after-cataracts, remnants of the oval lens capsule, left in the eye after surgery. According to the National Eye Institute, 90 percent of cataract patients who undergo surgery report that they see better after the operation. Although there is a small risk of injury to the eye during or after surgery, this can generally be treated before serious damage occurs.

at work. In one case that came to Crouse's office, a worker admitted her vision problem only after another secretary began using a closed-circuit television magnifier with the company's blessing.

Quality of lighting is an important factor in work sites, Crouse notes. In one office, sunlight falling on a video terminal turned out to be a major source of glare for a visually impaired worker; the simple but effective solution was to turn the terminal away from a nearby window. At another company, rose-colored paper taped over a fluorescent ceiling light made it easier for a worker to see.

Federally Sponsored Projects

Some workers qualify for free visual aids provided by state commissions on blindness or state vocational rehabilitation services. These state groups, as well as nonprofit organizations like the Sensory Aids Foundation, may also provide free work-site consultations and counseling for the visually impaired worker. Since 1968, the Rehabilitation Services Administration of the federal government has funded Projects with Industry, a nationwide group of activities encouraging employment of the disabled. Most projects work directly with industry, and each activity has a local advisory group of 15 to 25 business people. Among the 98 projects funded in 1984 were several that worked with advocacy groups and businesses, including the Rolm Telephone Company, to hire people with impaired vision.

Helping the Partially Sighted

The Center for Partially Sighted, located in Santa Monica, provides information, guidance, and referrals to people with partial sight (less than 20/70 vision in the better eye) throughout the United States. In the Santa Monica area, the center provides a special low-vision examination that takes into account patients' objectives and vision-related problems in their daily environment. An optometrist then determines which visual aids, if any, will help meet these goals. Technicians or optometric interns train patients in the use of the low-vision devices that are prescribed. In addition, psychologists, counselors, and a speaker's bureau from the center educate patients and the public about learning to cope with visual impairment. Since its inception in 1978, the center has aided more than 3,500 partially sighted people.

Optometry Schools

Optometry schools are another resource. Many have low-vision clinics that aid partially sighted workers. The Pennsylvania School of Optometry in Philadelphia, for example, offers vision screening exams to businesses, nursing homes, and community groups. The State University of New York College of Optometry evaluates vision screening programs and lighting requirements for some businesses in the New York metropolitan area. The University of Houston Optometry School

THE AGING EYE: A PERSONAL VIEW

Having been interested in vision all my life, it has been natural for me to observe what happens as I have gotten older.

I am certain that my adaptation to darkness is now poor, and I have data to confirm that. When I go from outdoors to indoors, it takes me longer than any of my colleagues to adjust my eyes to see what's going on.

More subjectively, I also notice that I have difficulty distinguishing blue colors. Offhand, I can't tell whether something is pink or lavender, because I am uncertain whether the color has a little blue in it or not. I do guess the correct color by introspection—if I'm "truly certain," it's probably lavender; if I'm not certain, it's probably pink.

My general impression is that I don't see as well as I think I should. In some ways I know my limitations—I expect to have trouble driving at night, so I've cut down on my night driving. On the other hand, I have great difficulty driving at twilight, especially in picking out particular areas of the street scene that I need to make sense of to know where I am. I've got into the habit of making a dry run in the middle of the afternoon if I know I have to visit somebody's house in the evening or nighttime. That way I don't get lost at twilight.

I have also noticed that some typefaces are easier to read than others. I have more difficulty reading with small interletter, interword, and interline spaces. I also have difficulty with low-contrast print and with printed pages with small borders. I find that placing a white typoscope—a white paper with a rectangular window cut out of it—improves the readability of both crowded and low-contrast print. The usual black typoscope also works, but not as well as a white one—the object is to isolate the print rather than cut back on the luminance of the background.

I want to stress that there is only a slight resemblance between the process of aging and chronological age. Older people are so diverse that just about anything you say about them applies to somebody, but often to no clear majority. Differences occur even among the young-old (65 to 74), the old (75 to 84), and the old-old (85 and over).

—Meredith Morgan, O.D., Ph.D.

Meredith Morgan, 74, is professor emeritus and former dean of the School of Optometry, University of California, Berkeley. He has monitored his vision as well as that of countless patients for more than four decades.

has a special clinic for the aging. In addition, Don Pitts, an optometrist at the Houston school, has surveyed lighting and studied the visual demands of working with video display terminals at several local computer and software companies. He and a university colleague teach a year-long course in environmental optometry, informing students about the different lighting requirements and visual demands of the office, school, factory, and motor vehicle. Design factors to enhance job efficiency and safety are discussed. According to Pitts, even small lighting deficiencies, glare, or a low-contrast work environment can be a major problem for a worker whose sight is already limited.

Conclusion

The aging of the human eye involves a series of changes in visual performance that can be readily detected in the healthy adult. Reduced visual functioning need not have any effect on job performance, but for some individuals it will.

It is obviously in the employer's interest to be responsive to the visual needs of older workers—indeed, of all workers. A firm may save considerable time and money in building and sustaining a productive work force through health care and employment policies in which vision care has been given a prominent role. Evidence suggests that much has already been done by some firms to meet the vision needs of their workers, but much more work lies ahead.

In order to make it possible for all workers to maintain their productivity in the face of changes in vision that typically occur with age, it will be necessary for scientists, manufacturers, and employers to pursue some common goals.

Scientists will need to give more emphasis to research that promotes suitable vision-screening procedures for older workers, for example, and to research that leads to a better understanding of the normal changes that occur in vision over the course of a person's life.

Manufacturers of devices used by older workers at the job site should develop new technologies or improve existing ones to meet the vision needs of older workers. Portable work units might permit older workers to adjust lighting to more comfortable levels, for example, and keyboards and panels should offer greater contrast between symbols and their backgrounds than they currently do—a change that might well benefit all workers.

Once advances such as these have been made, employers might have at their disposal the components of a vision-based employment program that would be sensitive to the vision needs of aging workers and suited to the unique tasks performed by all workers.

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